

Gamma Spec Protocol

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RadNet Gamma Spec Protocol
Thursday, February 19, 2004



RadNet Standard Header

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RadNet Message Header Format

The RadNet header contains the first 55 bytes of all RadNet messages. The header is intended to provide information regarding the operational status and location of an instrument. The header provides information regarding which instruments are (or are not) operating properly.

Field Name	Type	Position	Codes	Notes
Header Check Sum	Byte	1		The first byte (01, byte) is a checksum, to ensure the integrity of the header transmission. The checksum is the sum of bytes 2 through 55.
RadNet Version Number	Byte	2	See RadNet Versions Page	The second byte (02, byte) is the RadNet version number. It is used to indicate the version of the RadNet message. The receiving software is responsible for handling all received RadNet messages, although the most current version's functionality may not be provided.
Message Codes	Byte	3	See RadNet Message Codes Page	Byte (03) is the message code. The message code tells what type of RadNet message has been sent (status, check source, etc.).
Server Address	Word	4-5	None	Bytes (4-5) are the server address (1-64,536) of the pushing device. Since each instrument may perform as its own server, two bytes are used.
Monitor Address	Byte	6	None	Byte (6) is the address (1-256) of a specific monitor hooked up to a server. This protocol is intended to support existing (RS-485) systems. The practicality of hooking up more than 256 monitors to a single RadNet server is questionable.
Server Status	Byte	7	See RadNet Server Status Codes Page	Byte (7) is a code to display the status of the server. Codes are provided for normal as well as a variety of abnormal conditions.
Hardware Status	Byte	8	See Op/Hw Status Page Codes Page	Byte (8) is a code to display the overall Hardware Status of the instrument. Hardware status is intended to be a troubleshooting guide when responding to an abnormal condition. Instrument hardware malfunctions generally require repair work. Other conditions could be attributed to either hardware or operational problems. The instrument vendors are responsible for classifying conditions and prioritizing the status

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				change. The intention is that only the most critical status change be pushed; however a series of messages based upon a list of status changes could also be pushed. For example: If the instrument detected failures with low voltage, and low background, then the vendor could push each status in a separate message (at the abnormal push rate). These statuses could then be interpreted by the client as a HV power supply failure.
Operational Status	Byte	9	See Op/Hw Status Page Codes Page	<p>Byte (9) is a code to display the overall Operational Status of the instrument. Operational status is intended to be a troubleshooting guide when responding to an abnormal condition. Instrument operational problems generally require response by health physics personnel. Other conditions can be attributed to either hardware or operational problems. The instrument vendors are responsible for classifying conditions and prioritizing the status change. The intention is that only the most critical status change be pushed; however a series of messages based upon a list of status changes could also be pushed. For example: If the instrument detected failures with low voltage, and low background, then the vendor could push each status in a separate message (at the abnormal push rate). These statuses could then be interpreted by the client as a HV power supply failure.</p>
Location	Char[40]	10-49	None	<p>Bytes (10-49) are for the location of the instrument. Location designations are highly individual, so no convention or specification is given. The location label must be left justified. Unused characters must be padded with space characters.</p>
Authentication Byte Count Offset	Word	50-51		<p>The length in bytes of the original message. If non-zero, indicates that authentication is in effect. If zero, then authentication is not implemented</p> <p>See the following web pages for more information:</p> <p>Background Information RadNet Implementation, Authentication, Encryption</p>

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Authentication Status	Byte	52	See RadNet Authentication Status Codes Page	"Invalid" flag. This byte is always set to zero when the message is transmitted. Authentication services set this byte to a non-zero value if the message fails signature verification. Clients check this byte with zero meaning valid data and take appropriate "bad data" action if the byte is non-zero. See the following web pages for more information: Background Information RadNet Implementation , Authentication , Encryption
Reserved For Future Use	Byte	53	None	Byte (53) is reserved for future use and must be filled with zero values until specified by the protocol
Monitor Type	Word	54-55	See RadNet Monitor Type Codes Page	Bytes (54-55) are a code for the instrument type.

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Gamma Spec Message Body

Field Name	Type	Position	Codes	Notes
R1	Float	56-59	N/A	Reserved for Future use
R2	Float	60-63	N/A	Reserved For Future Use
Unique Id Preamble	Char [4]	C[1] = 64 C[2] = 65 C[3] = 66 C[4] = 67		The Unique ID Preamble is used in conjunction with the Unique ID. By combining the Unique ID Preamble and the Unique ID we obtain a totally unique ID for the message.
Unique Id	Float	68-71		Date + Time + <i>any other unique value</i> (e.g., mmddyyyyhhmmss + <i>mon address + server address</i> = 120219970812970462). If the gamma spec instrument supports more than 512 channels, then the spectrum must be shipped in multiple messages. The Preamble ID + Unique ID can also be used to match the spectrum data with the measurement data. If multiple messages are sent then the Preamble ID + Unique ID is used to match the multiple messages to one another as they are received by the client monitoring computer.
Message Type	Byte	72	0 = Measurement 1 = Spectrum 2 = Status See Gamma Spec Message Type Page.	If Message Type = 0 then see Gamma Spec Measurement Page. The Gamma Spec Measurement is pushed whenever the instrument has new measurements. If Message Type = 1 then see Gamma Spec Spectrum Page. This should be an instrument configurable setting (Turn on/off RadNet spectrum shipping). When spectrum shipping is turned on, the Gamma Spec Spectrum should be pushed after the measurement has been pushed or whenever analysis has been completed. This functionality is defined by the instrument manufacturer. If Message Type=2 then see Gamma Spec Status Page. The purpose of this message is to allow the instrument to transmit its status prior to final data analysis. Once the data has been collected and the measurements have been calculated, the instrument will send information using message type 0 and 1.

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Gamma Spec Spectrum Footer

The Gamma Spec (GS) Spectrum footer message has data conforming to generic GS formats. A RadNet header and body must precede all footer messages. The header contains the first 55 bytes of a RadNet message; the GS body contains the next 17 bytes, for a total of 72 bytes preceding the footer.

Repeating Frames of data are shown as $(131+y)+10(x)$. The 131 represent the 131 bytes that precede the footer. The "y" is the number of bytes that have preceded the value in that channel frame. The number 10 is the number of bytes in the frame. The "x" is the number of channel iterations that have occurred before the byte value is examined.

The instrument shall ship raw Spectrum data only. Massaging of the spectrum data by the instrument is not allowed when using the RadNet protocol. This limit allows client/monitoring software to perform its own analysis.

See Gamma Spec notes page for an example of the data stream format.

Note: Red Field Names = Repeating Fields

Field Name	Type	Position	Codes	Notes
Segment ID	Byte	73		Segment ID is the sequential identification number of segment that is being pushed. (e.g., Segment ID = 2 (2 OF 3) Number Of Segments = 3)
Number Of Segments	Byte	74		The number of segments is the total number of RadNet spectrum messages being pushed. If the Number Of Channels is > 512 channels then the GS must ship the spectrum message in multiple messages.
Live Time	Float	75-78		<p>The amount of time, during measurement, that the spectrometer is able to reliably resolve separate events in time.</p> <p>Live time is essentially the opposite of dead time. Dead time refers to the time that the nuclear-pulse electronics are busy processing one pulse and therefore cannot accept another. There are many methods (electronics, feedback) to correct for dead-time loss and beyond the scope of this discussion.</p> <p>Gamma-ray spectrometers are equipped with feedback electronics to track and correct for system dead time, reporting detector live time and real time during a measurement.</p> <p>Note: In connection with each spectrum analysis, it is critically important to account for live time in radionuclide quantification.</p>
Real Time	Float	79-82		Clock time. The actual time period for the

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				<p>duration of a measurement.</p> <p>Real time is always less than live time. As count rate increases, real time becomes a smaller fraction of live time.</p> <p>Gamma-ray spectrometers are equipped with an internal clock to track and report real time.</p>
Energy Calibration Offset	Float	83-86		<p>It is necessary to establish a relationship between the channel of the ADC and the energy of the incoming photon in order to establish the radionuclide. This relationship is mostly linear, but to accommodate minor non-linearities, the ADC is calibrated to energy using the following second-order relationship:</p> $E = \beta_0 + \beta_1 C + \beta_2 C^2$ <p>Where E is photon energy, C is Channel of the ADC, and β_0, β_1, β_2 are calibration fit coefficients from a least-squares fit of the calibration data.</p> <p>β_0 is the calibration offset, the value of E on a calibration graph of C versus E, corresponding to channel zero (C=0).</p> <p>Note: In connection with each spectrum analysis, the energy calibration slope (β_1) and offset (β_0) terms are used to determine the channels that are used to perform the analysis of the spectrum. The analysis regions are determined in units of energy, not in units of channels, and hence stay the same. The energy calibration information can also be used to display the spectrum with an energy x-axis.</p> <p>Units = keV</p>
Energy Calibration Slope	Float	87-90		<p>Energy Calibration Slope, β_1 in the equation above, is used to reproduce the spectrum as a function of Energy (rather than Channel). The slope coefficient is determined through calibration, using a radionuclide of known gamma-ray energies, creating a table of energy versus channel, and performing a least-squares fit to the data.</p>
Energy Calibration 2 nd Order Term	Float	91-93		<p>During the least-squares fit process associated with the calibration for energy, it is possible, though not likely, that a second-order non-linearity be introduced into relationship.</p>

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				Normally, the coefficient, β_2 , is zero. In the event that the calibration is not statistically linear, this coefficient provides an estimate for the degree of nonlinearity.
Start Channel Number	Word	94-95		<p>The Start Channel number is the starting channel number of the spectrum within this message, such as:</p> <p>Number Of Segments = 2 Segment ID = 1 Start Channel = 1 Stop Channel = 512 Number Of Channels = 512 Segment ID = 2 Start Channel = 513 Stop Channel = 1024 Number Of Channels = 512</p>
Stop Channel Number	Word	96-97		<p>The Stop Channel number is the ending channel number of the spectrum within this message. For example:</p> <p>Number Of Segments = 2 Segment ID = 1 Start Channel = 1 Stop Channel = 512 Number Of Channels = 512 Segment ID = 2 Start Channel = 513 Stop Channel = 1024 Number Of Channels = 512</p>
Number Of Isotope Labels (NOIL)	Byte	98		<p>NOIL is the number of repeating Isotope Labels (IL) contained within this message.</p> <p>If the GS does not support this field, then 0 (zero) should be entered.</p> <p>If the NOILs contains a 0 (zero) then the next 6 fields will be omitted and byte 99 will be the scaling factor.</p>
<i>Isotope Label Start Energy (IL)</i>	<i>Float</i>	<i>[(99+81x)-(102+81x)]</i>		<p><i>The Analysis Region Start Energy is the beginning energy for this IL(n) region.</i></p> <p><i>Units = keV</i></p>
<i>Isotope Label Stop Energy (IL)</i>	<i>Float</i>	<i>[(103+81x)-(106+81x)]</i>		<p><i>The Analysis Region Stop Energy is the ending energy for this IL(n) region.</i></p> <p><i>Units = keV</i></p>
<i>Label</i>	<i>Char[16]</i>	<i>[(107+81x)-</i>		<i>The Label is the isotope label for this IL(n) or</i>

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		(122+81x)]		<i>any other descriptor i.e. PU-239, U-235, Mixed, Mecial, etc.</i> <i>If the Label is <16 characters, then the unused bytes must be padded with space characters (ASCII Decimal 32)</i>
<i>Reliability Index (confidence Index)</i>	<i>Byte</i>	<i>[(123+81x)-(123+81x)]</i>	See Reliability Index Codes	<i>This Values is used to support draft ANSI Standard N42.34</i>
<i>Comment(s)</i>	<i>Char[40]</i>	<i>[(124+81x)-(163+81x)]</i>		<i>This value is used to hold comments concerning each IL. It can also be used to support ANSI Standard N42.34.</i> <i>Such as:</i> <i>Caution – SNM could be masked, Caution – interferences detected with signal, and so on.</i>
<i>Reserved For Future Use</i>	<i>8 Bytes</i>	<i>[(164+81x)-(171+81x)]</i>		<i>This is reserved space for future use.</i>
Scaling Factor	Float	<i>[(172+24x)-(175+24x)]</i>		Use this value to scale the largest reading to fit into the reading field, when the maximum number of counts/events > 64K. Client Software must take the reading multiplied by the scaling factor to obtain the actual results. e.g. For a reading of 88,480, the scaling factor would be 2.765 and the channel reading would be 32000 (32000 * 2.765 = 88480))
Number Of Channels (y)	Word	<i>(176+24x)-(177+24x)]</i>		The Number Of Channels is the number of readings/channels that will be presented as repeating frames.
<i>Reading</i>	<i>Word</i>	<i>(((178+(24x))+2)+2y)) - (((179+24x))+2)+(2y))..n</i>		<i>Reading is the counts/events for each channel.</i>

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Gamma Spec Measurement Footer

The Gamma Spec (GS) Measurement footer message has data conforming to generic GS formats and used in conjunction with the GS Spectrum Footer. A RadNet header and body must precede all footer messages. The header contains the first 55 bytes of a RadNet message; the GS body contains the next 13 bytes, for a total of 72 bytes preceding the footer

Note: Red Field Names = Repeating Frames/Fields

Note:...n indicates a repeating frame of data

Field Name	Type	Position	Codes	Notes
Segment ID	Byte	73	N/A	Segment ID is the sequential identification number of the segment that is being pushed. i.e.. Segment Id = 2 (2 OF n) Number Of Segments = 3
Number Of Segments	Byte	74	N/A	The number of segments is the total number of RadNet Spectrum footers being pushed. If the spectrum is > 512 channels, then the instrument must ship the spectrum in multiple messages.
Live Time	Float	75-78	N/A	<p>The amount of time, during measurement, that the spectrometer is able to reliably resolve separate events in time.</p> <p>Live time is essentially the opposite of dead time. Dead time refers to the time that the nuclear-pulse electronics are busy processing one pulse and therefore cannot accept another. There are many methods (electronics, feedback) to correct for dead-time loss and beyond the scope of this discussion.</p> <p>Gamma-ray spectrometers are equipped with feedback electronics to track and correct for system dead time, reporting detector live time and real time during a measurement.</p> <p>Note: In connection with each spectrum analysis, it is critically important to account for live time in radionuclide quantification.</p>
Real Time	Float	79-82	N/A	Clock time. The actual time period for the duration of a measurement. Real time is always less than live time.

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				As count rate increases, real time becomes a smaller fraction of live time. Gamma-ray spectrometers are equipped with an internal clock to track and report real time.
Calibration Month	Byte	83	N/A	Byte (83) is the month of the year
Calibration Day	Byte	84	N/A	Byte (84) is the day of the month
Calibration Year	Word	85-86	N/A	Bytes (85-86) are the year. This is all four digits of the year (1997, etc.)
Calibration Reference/Id	Char[20]	C[1]=87 C[2]=88 C[3]=89 C[4]=90 C[5]=91 C[6]=92 C[7]=93 C[8]=94 C[9]=95 C[10]=96 C[11]=97 C[12]=98 C[13]=99 C[14]=100 C[15]=101 C[16]=102 C[17]=103 C[18]=104 C[19]=105 C[20]=106	N/A	Used to reference the sample results to the calibration of the instrument The format of this character string is not specified. The Calibration Reference label must be left-justified. Unused characters must be padded with space characters.
Geometry Reference/Id	Char[20]	C[1]=107 C[2]=108 C[3]=109 C[4]=110 C[5]=111 C[6]=112 C[7]=113 C[8]=114 C[9]=115 C[10]=116 C[11]=117 C[12]=118 C[13]=119 C[14]=120 C[15]=121 C[16]=122 C[17]=123 C[18]=124 C[19]=125 C[20]=126		Used to reference the counting geometry for the sample data. The format of this character string is not specified. The Geometry Reference label must be left justified. Unused characters must be padded with space characters.
Isotope Library	Char[20]	C[1]=127	N/A	Used to reference the Isotopic Library

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Reference/Id		C[2]=128 C[3]=129 C[4]=130 C[5]=131 C[6]=132 C[7]=133 C[8]=134 C[9]=135 C[10]=136 C[11]=137 C[12]=138 C[13]=139 C[14]=140 C[15]=141 C[16]=142 C[17]=143 C[18]=144 C[19]=145 C[20]=146		that was used to obtain the sample results. The format of this character string is not specified. The Isotope Library Reference label must be left justified. Unused characters must be padded with space characters.
Instrument Serial Number/Id	Char[20]	C[1]=147 C[2]=148 C[3]=149 C[4]=150 C[5]=151 C[6]=152 C[7]=153 C[8]=154 C[9]=155 C[10]=156 C[11]=157 C[12]=158 C[13]=159 C[14]=160 C[15]=161 C[16]=162 C[17]=163 C[18]=164 C[19]=165 C[20]=166	N/A	
Number Of Measurement	Word	167-168	N/A	Byte (167-168) is the number of repeating frames that are contained after this value
Isotope	char[16]	C[1]=169..n C[2]= 170..n C[3]= 171..n C[4]= 172..n C[5]= 173..n C[6]= 174..n C[7]= 175..n C[8]= 176..n C[9]= 177..n C[10]= 178..n	N/A	Isotope is the primary isotope(s) associated with this measurement. i.e. PU-239, U-239, Background, Radon, Medical, etc.

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		C[11]= 179..n C[12]= 180..n C[13]= 181..n C[14]= 182..n C[15]= 183..n C[16]= 184..n		
Reading	Float	185-188..n	N/A	The calculated result for the Isotope.
Units	Byte	189..n	See RadNet Units Page	If the Isotope = CS-137, reading= 1.2, and the units set to 21 then the measurement would be 1.2 bq/m3 for CS-137.
Reading Percent Error	Float	190-193..n	N/A	Reading Percent Error is the error associated with the units above and is defined by the instrument manufacture. A common practice is to report percent relative standard deviation, which is the standard deviation divided by the mean value. Units = see unit above
Detectability Limit	Float	194-197..n	N/A	The Lower Limit of Detection (LLD) is defined by the instrument manufacture. It has been interchangeably used with the term Minimum Detectable Activity (MDA). In either definition, the field name "Detectability limit" passes this value, for the given radionuclide activity. Units = see units above
Reserved For Future Use	Byte[40]	198-237..n	N/A	Reserved for Future use.

Note:..n indicates a repeating frame of data

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Gamma Spec Status Message

The Gamma Spec Status Message is used to transmit the status of the instrument while it is collecting/analyzing the data. Because the Gamma Spec instrument may be required to collect data for several days or as long as a week before an analysis can be performed, RadNet provides this method to allow the instrument to inform the user of problems that may exist with the instrument during these long counting cycles.

If the "Number of Messages" field is set to 0, then no data will be found past byte 74. However, if the "Number of Messages" is set to a value greater than 0, then the instrument has sent a ASCII text message that can be displayed or archived. If the message is less than 40 characters long, then the instrument will pad the remaining space with space characters (Hex value = 20x or decimal value = 32). If the text is greater than 40 characters, then add another status message and increment the Number Of Messages field.

The instrument is still required to set the Operational and Hardware Status codes within the RadNet Header. Upon any status change within the instrument, the instrument shall push a status message and/or Measurement/Spectrum message.

When a valid analysis result has been completed by the instrument, it shall push the data using the Measurement and Spectrum message format. Then it should resume sending this status message at the normal/abnormal push rates.

The instrument manufacturer is responsible for deciding to implement the support of text messages, though it is not a requirement of the RadNet protocol. This option may or may not be implemented on all instrumentation.

The instrument manufacturers will define what messages to support and their content. The instrument manufacturer will define how many messages will be combined into one RadNet packet. Some instrument manufacturers may combine messages to reduce overhead and network traffic, while others will send only one status message per packet.

Here is an example of how this notion may be put into practice:

Packet Number 1	Number Of Messages = 3	Message 0= 'Taking Background Reading' Message 1= 'Stabilizing detector' Message 2= 'Counting Sample'
Packet Number 2	Number Of Messages = 4	Message 0= 'Moving Sample' Message 1= 'Sample Placed' Message 2= 'Stabilizing The Detector' Message 3= 'Counting Sample'
Packet Number 3	Number Of Messages = 1	Message 0= 'Count Complete, Analyzing Data'
Packet Number 4	Number Of Messages = 4	Message 0= 'Analysis complete' Message 1= 'Shipped Measurement' Message 2= 'Shipped Spectrum' Message 3= 'Standing By.'
Packet Number 5	Number Of Messages = 0	No extra status message sent, instrument using standard RadNet status messages to indicate the current state of the instrument.

Note: Red Field Names = Repeating Frames/Fields

Field Name	Type	Position	Codes	Notes
Number Of Messages	Word	73-74	N/A	Byte (73-74) is the number of repeating messages (frames) that are after this value If Number Of Messages = 0 then the client software should ignore the remaining byte.
Status Message	Char[40]	C[1]=75 C[2]=76		If the "Number of Messages" field is set to 0, then no data will be found past byte 74.

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		C[3]=77 C[4]=78 C[5]=79 C[6]=80 C[7]=81 C[8]=82 C[9]=83 C[10]=84 C[11]=85 C[12]=86 C[13]=87 C[14]=88 C[15]=89 C[16]=90 C[17]=91 C[18]=92 C[19]=93 C[20]=94 C[21]=95 C[22]=96 C[23]=97 C[24]=98 C[25]=99 C[26]=100 C[27]=101 C[28]=102 C[29]=103 C[30]=104 C[31]=105 C[32]=106 C[33]=107 C[34]=108 C[35]=109 C[36]=110 C[37]=111 C[38]=112 C[39]=113 C[40]=114		However, if "Number of Messages" is set to a value greater than 0, then the instrument has sent an ASCII text message that can be displayed or archived. If the message is less than 40 characters long, then the instrument will pad the remaining space with space characters (Hex value = 20x or decimal value = 32). If the text is greater than 40 characters then add another status message and increment the Number Of Messages field.
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Gamma Spec Notes/Comments

Gamma Spec Message = 0 then see Gamma Spec Measurement Footer Page. The Gamma Spec Measurement Footer is pushed whenever there are any status changes or an abnormal push frequency. This footer is optional and is not needed if no additional channel data is supplied.

If Gamma Spec Message = 1 then see Gamma Spec Spectrum Footer Page. This setting should be instrument configurable (Turn on/off RadNet spectrum shipping). When spectrum shipping is turned on, the Gamma Spec Spectrum Footer should be pushed after the measurement has been pushed whenever the monitor is alarmed. The monitor should always ship the measurement prior to shipping the spectrum.

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If Gamma Spec Message =2 then see Gamma Spec Status Message Footer Page. This setting should be instrument configurable (turn on/off RadNet Status shipping). When status shipping is turned on, the Gamma Spec Status Footer is shipped whenever the instrument is ideal or no status change has occurred with the instrument. When the instrument has valid data or upon a status change, it will push data using the Measurement, Spectrum, or Time Slice format and can be used in conjunction with any other the other RadNet Gamma Spec messages to inform the user of text messages. This message is not intend to be the only message being shipped by the instrument.

Example of Gamma Spec Status Message Format:

RadNet Field	Start Byte Position	End Byte Position	Notes
RadNet Header	1	55	
Gamma Spec Body	56	72	
Start Of Status Message Footer			
Number of Messages	73	74	Number of Messages=4
Start Of Messages Repeating Frame Data			
Status Message 0	75	114	Status Message 0 Value= 'Moving Sample'
End of Status Message 1 Data			
Status Message 1	115	154	Status Message 1 Value = 'Sample Placed'
End of Status Message 2 Data			
Status Message 2	155	194	Status Message 2 Value= 'Stabilizing The Detector'
End of Status Message 3 Data			
Status Message 3	195	234	Status Message 3 Value = 'Counting Sample'
End of Status Message 4 Data			
End Of Messages Repeating Frame Data			
End Of Status Message Footer			

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Example of Gamma Spectrum Message Format:

RadNet Field	Start Byte Position	End Byte Position	Notes
RadNet Header	1	55	
Gamma Spec Body	56	72	
Start Of Spectrum Message Footer			
Segment ID	73	73	
Number Of Segments	74	74	
Live Time	75	78	
Real Time	79	82	
Energy Calibration Offset	83	86	
Energy Calibration Slope	87	90	
Energy Calibration 2 nd Order Term	91	93	
Start Channel Number	94	95	
Stop Channel Number	96	97	
Number Of Isotope Labels (NOIL)	98	98	Number NOIL Value = 4
Start Of IL Repeating Frame Data			
Isotope Label (IL) Number 0			
IL Start Energy	99	102	Value = 700
IL Stop Energy	103	106	Value = 800
IL Label	107	122	Value = "Co-60*****" * = ASCII Code 32
IL Reliability Index	123	123	Value = 0
IL Comments(s)	124	163	Value = "Caution – SNM could be masked*****" * = ASCII Code 32
IL Reserved For Future Use	164	171	Value = 0
End of IL 1 Data			
Isotope Label (IL) Number 1			
IL Start Energy	172	175	Value = 1200
IL Stop Energy	176	179	Value = 1240

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IL Label	180	195	Value = "Co-59*****" * = ASCII Code 32
IL Reliability Index	196	196	Value = 0
IL Comments(s)	197	236	Value = "Caution – SNM could be masked*****" * = ASCII Code 32
IL Reserved For Future Use	237	244	Value = 0

End of IL 2 Data

Isotope Label (IL) Number 2			
IL Start Energy	245	248	Value = 1250
IL Stop Energy	249	252	Value = 1279
IL Label	253	268	Value = "Cs-137*****" * = ASCII Code 32
IL Reliability Index	269	269	Value = 0
IL Comments(s)	270	309	Value = "Caution – SNM could be masked*****" * = ASCII Code 32
IL Reserved For Future Use	310	317	Value = 0

End Of IL 3 Data

Isotope Label (IL) Number 3			
IL Start Energy	318	321	Value = 1300
IL Stop Energy	322	325	Value = 1310
IL Label	326	341	Value = "Cs-137*****" * = ASCII Code 32
IL Reliability Index	342	342	Value = 0
IL Comments(s)	343	382	Value = "Caution – SNM could be masked*****" * = ASCII Code 32
IL Reserved For Future Use	383	390	Value = 0

End Of IL 4 Data

End of IL Repeating Frame Data

Scaling factor	391	394	Value = 2.364598
Number of Channels	395	396	Number Of Channels Value = 11

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Start of Number Channels Repeating Frames

C0	397	398	
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C1	399	400	
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C2	401	402	
----	-----	-----	--

C3	403	404	
----	-----	-----	--

C4	405	406	
----	-----	-----	--

C5	407	408	
----	-----	-----	--

C6	409	410	
----	-----	-----	--

C7	411	412	
----	-----	-----	--

C8	413	414	
----	-----	-----	--

C9	415	416	
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C10	417	418	
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End of Number Channels Repeating Frames

End Of Spectrum Message Footer

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Example of Gamma Spec Measurement Footer Format:

RadNet Field	Start Byte Position	End Byte Position	Notes
RadNet Header	1	55	
Gamma Spec Body	56	72	See example above
Start Of Spectrum Message Footer			
Segment Id	73	73	Value = 1
Number of Segments	74	74	Value = 1 (1 of 1)
Live Time	75	78	Value = 30
Real Time	79	82	Value = 30
Calibration Month	83	83	Value = 1
Calibration Day	84	84	Value = 22
Calibration Year	85	86	Value = 2003
Calibration Reference Id	87	106	Value = "L1-2394-489-233*****" * = ASCII Code 32
Geometry Reference Id	107	126	Value = "L1-2394-489-233*****" * = ASCII Code 32
Isotope Library Reference Id	127	146	Value = "L1-2394-489-233*****" * = ASCII Code 32
Instrument Serial Number	147	166	Value = "12345-49589384984***" * = ASCII Code 32
Number Of Measurements	167	168	Value = 4
Start of Number Of Measurement Repeating Frames			
Isotope	169	184	"
Reading	185	188	
Units	189	189	
Reading Percent Error	190	193	
Delectability Limit	194	197	

Gamma Spec Protocol

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Reserved For Future Use	198	237
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End Of Measurement 0 Data

Isotope	238	253
---------	-----	-----

Reading	254	257
---------	-----	-----

Units	258	258
-------	-----	-----

Reading Percent Error	259	262
-----------------------	-----	-----

Delectability Limit	263	266
---------------------	-----	-----

Reserved For Future Use	267	306
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End Of Measurement 1 Data

Isotope	307	322
---------	-----	-----

Reading	323	326
---------	-----	-----

Units	327	327
-------	-----	-----

Reading Percent Error	328	331
-----------------------	-----	-----

Delectability Limit	332	335
---------------------	-----	-----

Reserved For Future Use	336	375
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End Of Measurement 2 Data

Isotope	376	391
---------	-----	-----

Reading	392	395
---------	-----	-----

Units	396	396
-------	-----	-----

Reading Percent Error	397	400
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Delectability Limit	401	404
---------------------	-----	-----

Reserved For Future Use	405	444
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End Of Measurement 3 Data

End of Number of Measurement Repeating Frames

End Of Measurement Message Footer

Gamma Spec Message Type Codes

Gamma Spec Protocol

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Gamma Spec (GS) Message Type Codes used to indicate the type of message being transmitted.

Code	Meaning	Notes
0	Measurement	Gamma Spec Measurement Data Follows the Gamma Spec body. See Gamma Spec Measurement Page for more information.
1	Spectrum	Gamma Spec Data Follows the Gamma Spec body. See Gamma Spec Spectrum Page for more information
2	Status	Gamma Spec Status Follows the Gamma Spec body. See Gateway Status Page for more information

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Authentication Status Codes

See the following pages for more information concerning RadNet Security Implementation:

Background Information

RadNet Security Implementation

Authentication

Encryption

These codes indicate whether a RadNet message has been authenticated (message fails signature verification). RadNet message(s) are directed to/at a RadNet Authentication Server (RAS) or other device. The RAS will authenticate the message and set byte 52 to indicate the status of the authentication process. The RAS server will then forward the message to clients on the network. It is important that the RAS server is secure and that the data leaving the RAS server is on a secure network (the message will not be tampered with after authenticated). It is also important to note that the RAS server does not strip the authentication keys from the message, and the authentication process could be done at any time, including storing the authentication signature within a database for future verification of the message.

The Authentication software/server will set this byte value to indicated message signature verification status.

Code	Meaning	Notes
0	Message is Ok	
>0	Message fails signature verification.	

Standard RadNet Header Codes

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RadNet Channel Types

Below is a code for type of channel.

Code	Meaning	Notes
0	Alpha	
1	Beta	
2	Gamma	
3	Neutron	
4	Iodine	
5	Noble Gas	
6	Tritium	
7	Stack Flow	
8	Sample Flow	
9	Temperature	
10	Sample Pressure	
11	Leak rate	Primary to secondary, or containment building leak
12	Reactor power	Used for leak measurements
13	Beta + Gamma	The sum of the beta and gamma channels.
14	Latitude	
15	Longitude	
16	Altitude	
17	Humidity	
18	Wind Speed	
19	Wind Direction	
20	Alpha/Beta	
21	Pulse Height Analysis (PHA)	
22	Dust Particle	
23	Humidity	
24	Anemometer	

Standard RadNet Header Codes

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RadNet Monitor Type Codes

Bytes (54-55) are code for the instrument type.

Code	Meaning	Notes
0	Gamma Area Monitor	Uses the Area Monitor body and footer format. See Area Monitor Header, Body, Footer, and Notes for more information.
1	Gamma Crit Monitor	Uses the Area Monitor body and footer format. See Area Monitor Header, Body, Footer, and Notes for more information.
2	Neutron Area Monitor	Uses the Area Monitor body and footer format. See Area Monitor Header, Body, Footer, and Notes for more information.
3	Neutron Crit Monitor	Uses the Area Monitor body and footer format. See Area Monitor Header, Body, Footer, and Notes for more information.
4	Alpha CAM	Uses the Alpha CAM body, Measurement Footer, Spectrum Footer. See Alpha CAM Header, Body, Measurement Footer, Spectrum Footer and Notes for more information.
5	Beta CAM	Uses the Beta Cam body and footer format. See Beta CAM Header, Body, Footer and Notes for more information.
6	PCM Monitor	Uses the PCM body and footer format. See PCM Header, Body, Footer and Notes for more information.
7	PCM Portal Monitor	Uses the PCM Body and Footer format. See Portal Header, Body, Footer and Notes for more information.
8	PING	Uses the PING Body and Footer format. See PING Header, Body, Footer and Notes for more information.
9	Glove Box Monitor/Hand Monitor	Uses The PCM Body and Footer format. See PCM Header, Body, Footer and Notes for more information.

Standard RadNet Header Codes

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10	Hand And Foot Monitor	Uses The PCM Body and Footer format. See Hand and Foot Header, Body, Footer and Notes for more information.
11	Generic Sensor	Uses The Generic Sensor Body and Footer format. See Generic Sensor Header, Body, Footer and Notes for more information.
12	Electronic Reading Dissymmetry	See Header, ERD Body, ERD Footer, for more information.
13	Item Contamination Monitor (ICM)	Uses The ICM Body and Footer format. See Header, Body, Footer and Notes for more information.
14	Radiation Gateway Monitor	Uses The Radiation Gateway Body and Footer format. See Header, Body, Footer and Notes for more information.
15	Gamma Spectrum	Uses The Gamma Spectrum Body, Measurement, Spectrum, Status and Footer format. See Header, Body, Measurement, Spectrum, Status and Notes for more information.
16	Portable Instruments	Protocol Pending, in development by vendor
17	Meteorology Tower	Uses The Meteorology Tower Body and Footer format. See Header, Body, Measurement, Status, and Notes for more information.
18	Video	Uses The Video Body, Status and Footer format. See Header, Body, Footer, Status and Notes for more information.
19	Image	Protocol Pending, in development by vendor
20	Audio	Protocol Pending, in development by vendor
21	Security data tag/seal	Protocol Pending, in development by vendor
22	Tritium Air Monitor	Protocol Pending, in development by vendor
23	Dust Particle Monitor	Protocol Pending, in development by vendor

Standard RadNet Header Codes

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RadNet Message Codes

Byte (03) is the message code. The message code indicates what type of RadNet message has been sent (status, check source, etc.).

Code	Meaning	Notes
0	Normal/Standard RadNet Message	Message is pushed by the instrument and received by the clients.
1	Alarm Ack	Message is pushed by the clients and received by the instruments. See Alarm Acknowledge Alarm Msg. Notes and Alarm Acknowledge Header Format
2	Pass Through	Message is pushed by the instrument and received by the client or can be pushed by the client and received by the instrument. This method can be used for bi-directional communication by the clients and instruments. See Pass Through Msg. Header Notes / Pass Through Header Format or Pass Through Codes
3	Check Source	Message is pushed by the clients and received by the instruments. See Check Source Msg. Notes and Check Source Header Format
4	Diagnostic/Self-Check	Message is pushed by the clients and received by the instruments. See Diagnostic/Self-Check Msg. Notes and Diagnostic/Self-Check Header Format
5	Request Data	A client/server sends this request to an instrument. In response to this request the instrument will send its current information (Normal RadNet Message). See Request Data Notes and Request Data Header Format
6	Update/Request Date/Time	A client/server sends this request to an instrument. In response to this request the instrument will send/set the date/time. See Update/Request Date/Time Notes and Update/Request Date/Time Header Format
7	Acknowledge Receipt	This message is used by the monitoring computer to acknowledge receipt of data from an instrument. See Acknowledge Receipt Message Header Format and Acknowledge Receipt Message Notes for more information.
255 (FFh)	Encrypted RadNet Message	See the following pages for more information: Background Information RadNet Implementation Encryption Header Message Format

Standard RadNet Header Codes

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	Encryption Background Information
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Standard RadNet Header Codes

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RadNet Operational and Hardware Status Codes

Note: It is the responsibility of the instrument manufacturer to prioritize the operational and hardware status for the instrument. Any status code can be used either as an operational or hardware status code base upon the instrument usage or needs.

Below is a code used to display the Hardware/Operational Status of the instrument. Hardware status is intended to be a troubleshooting guide when responding to an abnormal condition. Instrument hardware malfunctions generally require repair work. Other conditions may be attributed to either hardware or operational problems. Instrument vendors are responsible for classifying conditions and prioritizing the status change. The intention is that only the most critical status change be pushed; however a series of messages based upon a list of status changes could also be pushed. For example: If the instrument detected failures with low voltage and low background, the vendor could push each status in a separate message (at the abnormal push rate). These statuses could then be interpreted by the client as an HV power supply failure.

OP = Guide For Operational Status Use

HW = Guide For Hardware Status Use

Code	Meaning	OP	HW	Notes
0	Normal	Y	Y	
1	High Alarm	Y	N	
2	HV Fail	N	Y	
3	Count Fail	Y	N	
4	Bkg Fail	Y	N	
5	Bkg Update	Y	N	
6	Comm Fail	N	Y	
7	Gas Empty	Y	N	
8	Buffer Full	Y	Y	
9	Acked High Alarm	Y	N	
10	Flow Fail Low	Y	Y	
11	Flow Fail High	Y	Y	
12	Filter Door Open	Y	N	
13	Instrument Not Ready	Y	Y	
14	Instrument In Calibration Mode	Y	Y	
15	Fast Concentration Alarm	Y	N	
16	Slow Concentration Alarm	Y	N	
17	DAC Hours Alarm	Y	N	
18	Count Rate Alarm	Y	Y	
19	Release Rate Alarm	Y	N	

Standard RadNet Header Codes

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20	Fast Concentration Alarm Disabled	Y	N	
21	Slow Concentration Alarm Disabled	Y	N	
22	Count Rate Alarm Disabled	Y	N	
23	Check Source Mode	Y	N	
24	Out Of Service	Y	Y	
25	Alert Alarm	Y	N	
26	Trend Alarm	Y	N	
27	Not Initialized	Y	Y	
28	Standby	Y	Y	
29	Local Control	Y	Y	
30	Flush	Y	N	
31	Alarm Disabled	Y	N	
32	External Fail	Y	Y	
33	AC Off	Y	Y	
34	Crit Relay Fail	Y	Y	
35	Out Of Limits	Y	Y	
36	Crit Alarm	Y	N	
37	NV RAM Fail	N	Y	When the instrument's non-volatile RAM cannot be read/written.
38	Check Source Results	N	Y	Indicates that the message with this status carries check source results. This indicates that this message contains the final check source result at the completion of the check source integration. Prior to this code being sent the status code would be 23 (<i>Check Source Mode</i>).
39	Audio Failure	N	Y	Indicates that the instrument has a problem with its audio circuit.
40	Over Range	Y	Y	Indicates that the instrument has exceeded an Over Range value.
41	Diagnostic/Self-check completed, Passed self-check	Y	Y	Indicates that the instrument has performed an Internal Diagnostic/Self-check and found no error conditions. See Diagnostic/Self-Check Msg. Notes and Diagnostic/Self-Check Header Format

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42	Diagnostic/Self-check completed, Failed self-check	Y	Y	Indicates that the instrument has performed an Internal Diagnostic/Self-check and found error conditions. See Diagnostic/Self-Check Msg. Notes and Diagnostic/Self-Check Header Format
43	High/High Alarm	Y	N	Third alarm level used in many plants.
44	Internal stabilization failure	Y	N	From automatic energy stabilization.
45	Parameter error	Y	N	Bad setup.
46	Temperature failure	N	Y	Temperature out of operational range.
47	Power supply failure	N	Y	From power supply, or from voltage reading.
48	Analog input failure	N	Y	4-20 mA analog input failure (0 mA for example).
49	Filter failure	N	Y	Automatic filter advance failure (motor, end of roll...).
50	Detector cable failure	N	Y	
51	Electronic or Acquisition board failure	N	Y	Electronic failure.
52	Low Battery	N	Y	Backup battery or internal battery has a low voltage condition.
53	Battery Failed	N	Y	Backup battery or internal battery has failed.
54	Clock Failed	N	Y	Internal clock has failed.
55	User defined	Y	Y	This error code is used whenever an instrument supports user defined error codes. It is used whenever there is a desire to inform a user that one of their error conditions has been reached. Since there is no way of knowing what is contained in the error code logic, this generic response should be used to indicate the error.
56	Internal Communication Failure	N	Y	

Standard RadNet Header Codes

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RadNet Versions

Note: The last approved version in this list is the current version in use by RadNet.

The second byte (02, byte) is the RadNet version number. This number is used to indicate the version of RadNet be pushed by the server. It is the responsibility of the receiving software to handle all received RadNet messages, although the most current version's functionality may not be provided.

Version	Date Approved	Notes
0	Approved	

Standard RadNet Header Codes

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RadNet Units Codes

Below is a code for the RadNet units of the reading.

Code	Meaning	Notes
0	cps	
1	Rem/hr	
2	R/hr	
3	Sv/hr	
4	Bq/cm3	
5	Bq	
6	Degrees Centigrade (C)	Temperature Unit
7	Pascal (Pa)	Pressure Unit
8	cc	Flow Volume Unit
9	cc/sec	Flow Rate Unit
10	cps/cc	Activity Unit
11	counts	Counting Events Unit
12	cm/sec	Velocity Unit
13	bqMeV/cc	Gamma Gas Activity
14	degrees	Wind Direction (180 = south)
15	Gy/hr	Dose Rate Unit
16	RPU%	Reactor Power Unit
17	Kg/sec	Masse flow rate
18	n/cm2	Neutrons / cm2
19	n/cm3	Neutrons / cm3
20	DAC	Derived Air Concentration
21	bq/m3	Becquerel per cubic meter
22	bq/kg	Becquerel per kilogram
23	Latitude	
24	Longitude	
25	Mu_Hemin	Hemisphere North
26	Mu_Hemis	Hemisphere South
27	Mu_Hemie	Hemisphere East
28	Mu_Hemiw	Hemisphere West
29	Mu_Knots	Wind Speed (knots)
30	Mu_KPH	Wind Speed (knots per hour)
31	Mu_MPS	Wind Speed (meters per second)
32	Mu MPH	Wind Speed (meters per hour)

Standard RadNet Header Codes

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33	Mu_METERS	Altitude (meters)
34	Mu_Feet	Altitude (feet)
35	Mu_Percent	Humidity
36	Resistance	Electrical Resistance
37	um	Micro-meter

Standard RadNet Header Codes

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RadNet Server Status Codes

Byte (7) is a code that displays the status of the server. Codes are provided for normal as well as a variety of abnormal conditions. See Appendix A for Server Status message codes.

Code	Meaning	Notes
0	Normal Operation	
1	Instrument Communication Error	
2	TCP Communication Error	
3	UDP Communication Error	
4	Hard Disk Full	
5	Password Fail	
6	Starting Up	
7	Shutting Down	
8	Program Error	
9	NetWork Access Granted	
10	NetWork Access Denied	